(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 028 412 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**16.08.2000 Bulletin 2000/33**

(51) Int Cl.[7]: **G11B 7/00**, G11B 7/13

(21) Application number: **99310505.5**

(22) Date of filing: **23.12.1999**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE**
Designated Extension States:
**AL LT LV MK RO SI**

(30) Priority: **12.02.1999 KR 9904982**

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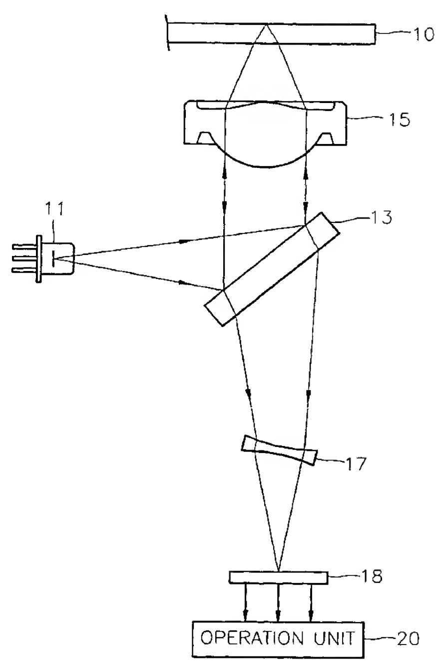
(54) **Optical pickup apparatus for reducing cross talk between adjacent tracks**

(57) An optical pickup apparatus capable of reducing cross talk between adjacent tracks, includes a photodetecting means (18) for dividing a single light beam reflected from the recording medium into a center portion (A) and side portions (B/C) with respect to the radial direction of the recording medium (10) and receiving the incident light in the divided form; and an operation unit (20) for multiplying the signals of the side portions by an operation constant (K) and adding the results and the detected signal of the center portion (A), and outputting an information signal of a main track. Such an optical pickup apparatus can, in real time, detect the information signal of the main track whilst reducing cross talk from adjacent tracks, and since the optical efficiency of the single light beam spot formed on the main track is not lowered, recording of an information signal can be performed with the optical pickup apparatus.

FIG. 4

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## Description

[0001] The present invention relates to an optical pickup apparatus, and more particularly, to an optical pickup apparatus capable of reducing cross talk between adjacent tracks occurring when a high capacity recording medium having a narrow track pitch is recorded or reproduced.

[0002] In order to increase the capacity of a recording medium, development is centered on using a light source of a shorter wavelength and an objective lens having a larger numerical aperture when recording/reproducing the recording medium. That is, as an optical recording medium, a compact disk (CD) which uses an infrared light source of a wavelength of 780 nm and an objective lens having a numerical aperture of 0.45 is replaced by a digital versatile disk (DVD) which uses a light source of a wavelength of 650 nm and an objective lens having a numerical aperture of 0.6. In addition, to change specifications from the CD to the DVD and enhance the density of recording, development is centered to reduce the track pitch of a recording medium.

[0003] However, in the case of a recording medium having a narrow track pitch, cross talk between adjacent tracks may deteriorate the reproduction of a recorded signal.

[0004] Here, when a recording medium is recorded/reproduced by an optical pick-up apparatus, the degree of deterioration of the signal by adjacent tracks is defined by cross talk between the tracks, and an allowable value is set according to a recording medium. For example, in order to acquire a high quality reproduced signal in the case of a DVD-ROM, the DVD is required to have a cross talk value less than -30 dB.

[0005] A DVD-ROM uses an objective lens of a numerical aperture of 0.6 and a light source of a wavelength ($\lambda$) of 650 nm, is manufactured to have a track pitch of 0.74 $\mu$m, and has a capacity of 4.7 GB. Since the size of a beam spot determining a recording capacity is proportional to $\lambda$/NA, in the above case, $\lambda$/NA is 1.08. Therefore, the ratio of the track pitch (Tp) to the beam spot is $Tp \times NA/\lambda = 0.68$, and the cross talk between adjacent tracks has a value lower than -30dB.

[0006] Since an HD-DVD which is expected to attract public attention as a high density recording medium in the near future requires a capacity greater than 15 GB, the ratio of the track pitch to the beam spot must be lower than 0.6, and in this case the cross talk caused by adjacent tracks increases. For example, when a HD-DVD uses a light source of a wavelength of 410 nm and an objective lens of a numerical aperture of 0.6, and the track pitch is set to 0.368 $\mu$m so as to have a capacity of 15 GB, cross talk caused by adjacent tracks has a very high value higher than -20 dB. Therefore, in order to prevent deterioration of a reproduced signal, an optical pickup apparatus which is adapted to reduce cross talk caused by adjacent tracks is required.

[0007] Figure 1 shows a conventional optical pickup apparatus capable of reducing cross talk between adjacent tracks.

[0008] Referring to Figure 1, light emitted from a light source 1 is diffracted by a grating 2, and is separated into three light beams of a zero order diffracted light beam and ± first order diffracted light beams. After the beams are reflected on a beam splitter 3, the reflected beams are converged by an objective lens 5 and form three light beam spots S1, S2 and S3 at positions different from each other on an optical disk 10 as shown in Figure 2. That is, the zero order diffracted light beam forms the light beam spot S1 on a main track T1 from which an information signal is reproduced, and the ± first order diffracted light beams form the light beam spots S2 and S3 on first and second adjacent tracks T2 and T3 adjacent to the main track T1, respectively.

[0009] At this time, as shown in Figure 2, the light beam spots formed on the optical disk 10 are formed on the main track T1 and the adjacent tracks T2 and T3 to be slanted with respect to each other. That is, the light beam spot S2 formed on the first adjacent track T2 precedes the light beam spot S1 formed on the main track T1, and the light beam spot S3 formed on the second adjacent track T3 goes behind the light beam spot S1. Here, since side portions of the individual light beam spot lie over adjacent tracks due to the narrow track pitch, the zero order diffracted light beam and the ± first order diffracted light beams form the light beam spots not only on the corresponding tracks but also on the adjacent tracks.

[0010] The light beams which were reflected from the optical disk 10 and passed through the objective lens 5 pass through the beam splitter 3 and are detected by a photodetector 8 which is provided with first, second and third light receiving portions A, B and C performing photoelectrical conversion independently of each other. That is, the three light beams reflected from the respective tracks of the optical disk 10 are received by the respective light receiving portions A, B and C of the photodetector 8 as shown in Figure 3.

[0011] Here, reference number 4 denotes a reflective mirror, and reference number 7 denotes a sensing lens which condenses incident light beams on the photodetector 8.

[0012] In the optical pickup apparatus structured as described above, an information signal to be detected is a signal which is reflected from the main track T1 and received by the second light receiving portion B. However, since portions of the light beam spot S1 by the zero order diffracted light beam are formed over the first and second adjacent tracks T2 and T3, the detected signal of the second light receiving portion B includes not only the signal of the main track T1 but also the signals of adjacent tracks, which are intermixed therewith. Therefore, the information signal of the main track T1 is detected by performing a differential operation on the detected signal of the second light receiving portion B and the signals of adjacent tracks detected by the first and

third light receiving portions A and C. When the light receiving portion and the signal detected by the light receiving portion are expressed by the same symbol, the RF signal of the main track T1 is expressed by the following Equation (1)

$$\text{RF signal} = B - K \times [A + C] \qquad (1)$$

where K is a constant which is determined so that vibrations in the time axis of the information signal of the main track T1 can be minimized, i.e., a constant which is determined so that cross talk by the adjacent tracks T2 and T3 can be minimized.

**[0013]** On the other hand, since the three beams diverged by the grating 2 are converged on respective tracks to form the light beam spots which are slanted with respect to each other as shown in Figure 2, the signals of the adjacent tracks which are detected by the first and third light receiving portions A and C are delayed for a constant time with respect to the signals of the adjacent tracks which are included in the signal detected by the second light receiving portion B. Therefore, it is not possible to perform a real-time operation so as to detect the information signal of the main track, and there is a problem in that signals which are delayed for the constant time with respect to the detected signal B are used as the signals A and C of the adjacent tracks.

**[0014]** In addition, in the above method of reducing cross talk by adjacent tracks, since three light beam spots must be formed on respective tracks of the optical disk 10, the optical efficiency of the light beam spot S1 for recording/reproducing the information signal of the main track T1 is lowered, and it is difficult to use the light beam spot S1 for recording.

**[0015]** It is an aim of at least preferred embodiments of the present invention to provide an optical pickup apparatus capable of detecting, in real-time, an information signal of a main track in which cross talk between adjacent tracks is reduced, and capable of reducing cross talk by adjacent tracks without lowering the optical efficiency of a light beam spot.

**[0016]** According to the present invention there is provided an optical pickup apparatus as set forth in claim 1 appended hereto. Preferred features of the present invention will be apparent from the dependent claims and the description which follows.

**[0017]** According to the one aspect of the present invention there is provided an optical pickup apparatus capable of reducing cross talk by adjacent tracks including a light source for emitting a light beam, a light path changing means disposed on the optical path between the light source and a recording medium for changing the path of an incident light beam, an objective lens disposed on the optical path between the light path changing means and the recording medium for converging an incident light onto the recording medium, and a photodetecting means receiving the incident light beam which is reflected from the recording medium and then passes through the light path changing means, characterized in that optical pickup apparatus includes: the photodetecting means dividing the incident light beam into a center portion and side portions with respect to the radial direction of the recording medium and receiving the incident light in the divided form; and an operation unit for operating the detected signals of the center portion and the side portions of the incident light beam from the photodetecting means and outputting an information signal of a main track reduced in cross talk by adjacent tracks.

**[0018]** Preferably, the photodetecting means is a photodetector comprising a main light receiving portion which receives the center portion of the incident light beam, and at least one auxiliary light receiving portion which is disposed at a side of the main light receiving portion with respect to the radial direction of the recording medium to receive the at least one side portion of the incident light beam apart from the main light receiving portion.

**[0019]** Preferably, the photodetecting means is a photodetector comprising two auxiliary light receiving portions disposed either side of the main light receiving portion with respect to the radial direction of the recording medium to receive respective side portions of the incident light beam independently of the main light receiving portion.

**[0020]** Preferably, the main light receiving portion has a predetermined size so as to receive the center portion within a range of about 10 to 90% of the incident light beam.

**[0021]** Preferably, the photodetecting means comprises an optical member for directly passing the center portion of the incident light beam and for diffracting at least one side portion of the incident light beam at a predetermined angle, thereby separating the incident light beam into the center and at least one side portion in a radial direction; and a plurality of photodetectors for photoelectrically converting the separated light beams into electrical signals independently of each other.

**[0022]** Preferably, the optical member comprises a central light passing portion and hologram pattern portions arranged to produce +/- first order diffracted light beams either side of the central light passing portion, respectively.

**[0023]** Preferably, the operation unit includes a multiplier for multiplying the detected signals of the at least one side portion of the incident light beam by an adjusting operation constant K so that cross talk by adjacent tracks can be minimized; and an adder for adding the signal output from the multiplier and the detected signal of the main light receiving portion of the incident light beam, to produce an information signal in which cross talk is reduced.

**[0024]** Preferably, the operation unit comprises a second adder for adding the detected signals of each side portion and supplying the result to the multiplier.

**[0025]** Preferably, the operation constant has a value

which is approximately 1 or higher. Preferably, the operation constant (K) is selected to be approximately 1.8 or approximately 2.0.

**[0026]** For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

Figure 1 is a diagram illustrating an optical layout of a conventional optical pickup apparatus capable of reducing cross talk between adjacent tracks;

Figure 2 is a plan view illustrating a portion of tracks of a conventional optical disk;

Figure 3 is a plan view schematically illustrating the photodetector shown in Figure 1;

Figure 4 is a diagram illustrating an optical layout of an optical pickup apparatus capable of reducing cross talk between adjacent tracks according to an embodiment of the present invention;

Figure 5 is a block diagram schematically illustrating the structures of the photodetector and operation unit shown in Figure 4;

Figure 6 is a plan view schematically illustrating an example of pits of recording medium for describing a principle of reducing cross talk by adjacent tracks in an optical pickup apparatus according to the present invention;

Figure 7 is a graph schematically illustrating a detected signal when reproducing a main track of the recording medium shown in Figure 6 by an optical pickup apparatus according to the present invention;

Figures 8A and 8B are graphs illustrating the amounts of cross talk with respect to operation constant K values when a recording medium having a track pitch of 0.368 μm and the pits shown Figure 6 is reproduced by an optical pickup apparatus under a condition in which the wavelength of a light source is 410 nm, and the numeral aperture of an objective lens is 0.6;

Figure 9 is a diagram illustrating an optical layout of an optical pickup apparatus capable of reducing cross talk by adjacent tracks according to another embodiment of the present invention;

Figure 10 is a plan view schematically illustrating an embodiment of the optical diffraction element shown in Figure 9; and

Figure 11 is a block diagram schematically illustrating first, second and third photodetectors and an operation unit shown in Figure 9.

**[0027]** Figure 4 is a diagram illustrating an optical layout of an optical pickup apparatus capable of reducing cross talk caused by adjacent tracks according to an embodiment of the present invention. Referring to Figure 4, the preferred optical pickup apparatus comprises a light source 11 for emitting light, a light path changing means disposed on the optical path between the light source 11 and a recording medium 10 for changing a path of an incident light, an objective lens 15 disposed on the optical path between the light path changing means and the recording medium 10 for converging an incident light onto the recording medium 10, a photodetecting means for dividing the incident light beam and receiving the incident light in the divided form, and an operation unit 20 for operating the detected signal from the photodetecting means and outputting an information signal reduced in cross talk between adjacent tracks. Here, reference numeral 17 indicates a sensing lens.

**[0028]** A beam splitter 13 may be provided as the light path changing means. The beam splitter 13 changes traveling paths of incident light beams so that the beam splitter 13 can, for example, reflect most of the light beam and direct the reflected beam to the recording medium 10, and permit most of the incident beam reflected from the recording medium 10 to pass therethrough. Here, it is possible that a hologram element (not shown) may be provided as the light path changing means. The hologram element directly passes the incident light from the light source 11, and diffracts the incident light from the recording medium 10 toward the photodetecting means at a predetermined angle. In this case, the light source 11, the hologram element and the photodetecting means can be modularized.

**[0029]** The photodetecting means divides the incident light beam which is reflected from the recording medium and then passes through the light path changing means into a center portion and side portions with respect to the radial direction of the recording medium 10 and receives the incident light in the divided form.

**[0030]** In this embodiment, the photodetecting means is provided with a photodetector 18 which is configured to separately receive the center portion and side portions of the incident beam as shown in Figure 5. The photodetector 18 comprises a main light receiving portion A which receives the center portion of the incident light beam, and auxiliary light receiving portions B and C which are disposed at respective sides of the main light receiving portion A with respect to the radial of the recording medium 10 and receive the side portions of the incident light beam independently of the main light receiving portion A. Here, it is possible that one auxiliary light receiving portion B or C may be disposed at one side of the main light receiving portion A and receive one side portion of the incident light beam.

**[0031]** At this time, the main light receiving portion A has a predetermined size so as to receive the center portion within the range of about 10 to 90% of the incident light beam. Here, the optimum size of the main light receiving portion A which can, as will be described below, minimize the amount of cross talk by adjacent tracks can be decided with relation to the overall layout of an optical pickup apparatus according to the present invention and a value of operation constant K to be described below, and the possible range of the size is as mentioned above.

**[0032]** The operation unit 20 operates a detected signal A of the center portion of the incident light beam and detected signals B and C of the side portions of the incident light beam and removes cross talk by adjacent tracks included in the signal of the main track of the recording medium 10. The operation unit 20 comprises a first adder 21 which adds signals photoelectrically converted at and output from the first and second auxiliary light receiving portions B and C, a multiplier 23 which multiplies signals (B +C) output from the first adder 21 by the operation constant K, and a second adder 25 which adds the signal A photoelectrically converted at and output from the main light receiving portion A and the signal output from the multiplier, i.e., K(B + C).

**[0033]** Here, the operation constant K is a constant which is decided so that cross talk by adjacent tracks included in an information signal detected through the second adder 25, i.e., vibrations in the time axis of the information signal can be minimized. It is preferable that the operation constant K has a value more than about 1. Such an operation constant K value is an effective value which allows cross talk by adjacent tracks to be minimum in an optical pickup apparatus. The operation constant K value minimizes cross talk by adjacent tracks with respect to the main light receiving portion A having a size receiving the center portion within the range of about 10 to 90% of an incident light.

**[0034]** At this time, it is preferable that the multiplier 23 is designed to adjust the operation constant K. This is intended to set the optimum operation constant K value in response to situations at the time when an optical pickup apparatus is assembled and/or when the specifications of the recording medium 10 to be recorded/reproduced are changed, etc. At this time, the multiplier 23 may be provided to adjust the operation constant K in the range of more than about 1.

**[0035]** On the other hand, when the auxiliary light receiving portion (B or C) is provided at only one side of the main light receiving portion A, the operation unit according to the present invention is merely composed of the multiplier 23 and the second adder 25.

**[0036]** Now, the principle of reducing cross talk caused by adjacent tracks with the above described optical pickup apparatus will be described in detail with reference to an example in which pits of the recording medium 10 are as shown in Figure 6.

**[0037]** Referring to Figure 6, pits are formed along a main track T1 on a first interval D1 of the recording medium 10, another pits are formed along a first adjacent track T2 on a second interval, and still another pits are formed along the first adjacent track T2 and a second adjacent track T3. Here, when alternating components of the reproduced signal on the first and third intervals D1 and D3 are respectively X and Y, the cross talk by the adjacent tracks is defined as 20LOG(Y/X).

**[0038]** A light beam emitted from the light source 11 is converged by the objective lens 15 and forms a beam spot on the main track T1. At this time, the beam spot spreads over the first and second adjacent tracks T2 and T3 as well as the main track T1 due to a narrow track pitch. Therefore, the detected signal A of the main light receiving portion A and the detected sum signal B + C of the first and second auxiliary light receiving portions B and C are expressed as a graph shown in Figure 7. Here, the traverse axis indicates movement of the beam spot (the direction of an arrow in Figure 6) along the track direction. In addition, the longitudinal axis indicates detected signal values in an arbitrary unit.

**[0039]** Referring to Figure 7, though the detected signal A of the main light receiving portion A and the sum signal B + C of the detected signals of the auxiliary light receiving portions B and C are approximately in phase with each other on the first interval, they are about 180° out of phase with each other on the second and third intervals D2 and D3. Accordingly, the reproduced signal A + B + C which is the sum of the detected signals as they are, exhibits alternating components on the interval where pits are not formed on the main track T1, for example, the third interval D3 due to the interference of adjacent tracks T2 and T3. Therefore, cross talk by adjacent tracks becomes a high value higher than about -20 dB.

**[0040]** However, if the sum signal B + C of the detected signals of the auxiliary light receiving portions B and C is multiplied by the operation constant K = 2.0, the compensated reproduced signal which is the sum of the above signal and the detected signal of the main light receiving portion A, i.e., A + 2.0(B + C) is a signal in which alternating components are removed on the third interval D3 where pits are not formed on the main track T1 as shown in Figure 7.

**[0041]** Therefore, when information signal is detected by adding the detected signal of the main light receiving portion A which receives the center portion of the incident light beam and a signal produced by multiplying the detected signal of the auxiliary light receiving portions B and/or C which receive the side portions of the incident light beam by appropriate operation constant K, an excellent information signal (an RF (radio frequency) signal) in which cross talk by adjacent tracks are remarkably reduced can be reproduced even when the recording medium 10 has a relatively narrow track pitch.

**[0042]** Figures 8A and 8B are graphs of the amounts of cross talk calculated according to operation constant K values respectively when the recording medium 10

having a track pitch of 0.368 μm and the track pattern shown in Figure6 is reproduced by a preferred optical pickup apparatus under the condition in which the wavelength of the light source 11 is 410 nm and the numerical aperture of the objective lens 15 is 0.6.

**[0043]** Figure 8A shows a graph of cross talk calculated according to operation constant K values when the main light receiving portion A is provided to receive 1/3 the center portion of the incident light, in which cross talk has the minimum value lower than -40 dB when the operation constant K = 2.0.

**[0044]** Figure 8B shows a graph of cross talk calculated according to operation constant K values when the main light receiving portion A is provided to receive % the center portion of the incident light, in which cross talk has the minimum value lower than -40 dB when the operation constant K = 1.8.

**[0045]** As described above, the optimum value of the operation constant K can be decided in connection with the overall layout of an optical pickup apparatus, which permits cross talk to have a minimum value lower than -30 dB with respect to the main light receiving portion A having a size for receiving a predetermined percentage of the center portion of the incident light beam, i.e., a predetermined percentage of within the range of about 10 to 90%.

**[0046]** Therefore, when the main light receiving portion A of the photodetector 18 is provided so as to receive the center portion of the incident light in the range of about 10 to 90%, and an appropriate operation constant is decided corresponding to the size of the main light receiving portion A, an information signal (an RF signal) can be detected in which cross talk by adjacent tracks is reduced.

**[0047]** Accordingly, if the preferred optical pickup apparatus is used, an excellent information signal having cross talk lower than -30 dB can be detected even when a HD-DVD in which the ratio of a track pitch to a beam spot is lower than 0.6 since a storage capacity higher than 15 GB is required.

**[0048]** In addition, since the preferred optical pickup apparatus forms only one beam spot, the intensity of the beam spot focused on the main track is stronger than a conventional optical pickup apparatus in which 3 beam spots are formed on the recording medium 10. Therefore, since the optical pickup apparatus can form a beam spot having a sufficient intensity on the main track, it can be used as a recording apparatus for recording an information signal on the recording medium 10.

**[0049]** Figure 9 shows a diagram schematically illustrating an optical layout of an optical pickup apparatus capable of reducing cross talk between adjacent tracks according to another embodiment of the present invention, in which the same reference numerals as in Figure 4 indicate the same members. In this embodiment, a photodetecting means comprises an optical member 30 for directly passing the center portion of an incident light beam in a radial direction and for diffracting the side portions of the incident light beam at a predetermined angle, thereby separating the incident light beam into the center and side portions, and a plurality of photodetectors 38a, 38b and 38c for photoelectrically converting the separated light beams into electrical signals. Here, though the optical member 30 is shown to be disposed on the optical path between a sensing lens 17 and the photodetectors 38a, 38b and 38c, the optical member 30 can be disposed between a light path changing means and the sensing lens 17.

**[0050]** As shown in Figure 10, the optical member 30 is composed of a light passing portion 30a for directly passing the center portion of the incident light beam in a radial direction, and pattern portions 30b and 30c for diffracting the side portions of the incident light beam at a predetermined angle. The light passing portion 30a may be a transparent member or an open aperture (not shown). In the pattern portions 30b and 30c, patterns, for example, hologram patterns are formed so that the patterns can diffract the incident light beam to produce a - first order diffracted light beam and a + first order diffracted light beam.

**[0051]** At this time, the light passing portion 30a has a size designed to directly pass about 10 to 90% of the center portion of the incident light beam as the main light receiving portion A of the previous embodiment of the present invention.

**[0052]** As shown in Figure 11, the main photodetector 38a receives the center portion of the light beam having passed the light passing portion 30a. The auxiliary photodetectors 38b and 38c are disposed at the sides of the main photodetector 38a in a radial direction of the recording medium 10, and receive the side portions of the light beam having been diffracted at and passed the pattern portions 30b and 30c, respectively.

**[0053]** Here, one of the pattern portions 30b and 30c may comprise a shielding member (not shown). In this case, the auxiliary photodetector 38b or 38c is disposed corresponding to the pattern portions.

**[0054]** Since the principle and operation of reproducing an information signal in which cross talk by adjacent tracks is reduced by the above described optical pickup apparatus are the same as the previous embodiment of the present invention, the description will be omitted.

**[0055]** Here, it should be understood that various modifications and equivalents of an optical pickup apparatus according to the present invention may be made.

**[0056]** The above-described optical pickup apparatus according to the present invention illuminates one beam spot on the track of a recording medium, detects the center and side portions, with respect to a radial direction of the recording medium, of the light beam reflected from the recording medium, separately, multiplies the detected signal of the side portions by an operation constant, and adds the result and the detected signal of the center portion, thereby reproducing a main track information signal reduced in cross talk by adjacent tracks

in real time.

**[0057]** Therefore, even when information is reproduced from a high capacity recording medium having a narrow track pitch, in particular, a HD-DVD in which the ratio of a beam spot to a track pitch is decided to be a value less than 0.6, an excellent reproduced signal can be obtained in real time in which cross talk by adjacent tracks is reduced. In addition, since the optical efficiency of a beam spot focused on the main track is not lowered, recording of an information signal is possible.

**[0058]** The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

**[0059]** All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

**[0060]** Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

**[0061]** The invention is not restricted to the details of the foregoing embodiment(s). The invention extend to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

## Claims

1. An optical pickup apparatus for reducing cross talk between adjacent tracks of a recording medium, the apparatus including a light source (11) for emitting a light beam, a light path changing means (13) disposed on the optical path between the light source and a recording medium (10) for changing the path of an incident light beam, an objective lens (15) disposed on the optical path between the light path changing means (13) and the recording medium (10) for converging an incident light onto the recording medium (10), and a photodetecting means (8) for receiving an incident light beam which is reflected from the recording medium and passed through the light path changing means,
 characterized by:

 the photodetecting means (18) for dividing the incident light beam into a center portion and at least one side portion with respect to the radial direction of the recording medium and receiving the incident light in the divided form; and

 an operation unit (20) for operating the detected signals of the center portion and the at least one side portion of the incident light beam from the photodetecting means and outputting an information signal of a main track.

2. The optical pickup apparatus as claimed in claim 1, wherein the photodetecting means (18) is a photodetector comprising a main light receiving portion (A) which receives the center portion of the incident light beam, and at least one auxiliary light receiving portion (B/C) which is disposed at a side of the main light receiving portion (A) with respect to the radial direction of the recording medium (10) to receive the at least one side portion of the incident light beam apart from the main light receiving portion.

3. The optical pickup apparatus as claimed in claim 2, wherein the photodetecting means is a photodetector comprising two auxiliary light receiving portions (B,C) disposed either side of the main light receiving portion (A) with respect to the radial direction of the recording medium (10) to receive respective side portions of the incident light beam independently of the main light receiving portion (A).

4. The optical pickup apparatus as claimed in claim 2 or 3, wherein the main light receiving portion (A) has a predetermined size so as to receive the center portion within a range of about 10 to 90% of the incident light beam.

5. The optical pickup apparatus as claimed in any of claims 1 to 4, wherein the photodetecting means comprises:

 an optical member (30) for directly passing the center portion of the incident light beam and for diffracting at least one side portion of the incident light beam at a predetermined angle, thereby separating the incident light beam into the center and at least one side portion in a radial direction; and

 a plurality of photodetectors (38a,38b) for photoelectrically converting the separated light beams into electrical signals independently of each other.

6. The optical pickup apparatus as claimed in claim 5, wherein the optical member (30) comprises a central light passing portion (38) and hologram pattern portions (30b,30c) arranged to produce +/- first order diffracted light beams either side of the central

light passing portion (30a) respectively.

7. The optical pickup apparatus as claimed in any of claims 1 to 6, wherein the operation unit (20) includes: a multiplier (23) for multiplying the detected signals of the at least one side portion of the incident light beam by an adjusting operation constant K so that cross talk by adjacent tracks can be minimized; and an adder (25) for adding the signal output from the multiplier and the detected signal of the main light receiving portion of the incident light beam, to produce an information signal in which cross talk is reduced.

8. The optical pickup apparatus as claimed in claim 7, wherein the operation unit (20) comprises a second adder (21) for adding the detected signals of each side portion and supplying the result to the multiplier (23).

9. The optical pickup apparatus as claimed in claim 7 or 8, wherein the operation constant has a value which is approximately 1 or higher.

10. The optical pickup apparatus as claimed in any of claims 7 to 9, wherein the operation constant (K) is selected to be approximately 1.8 or approximately 2.0.

FIG. 1

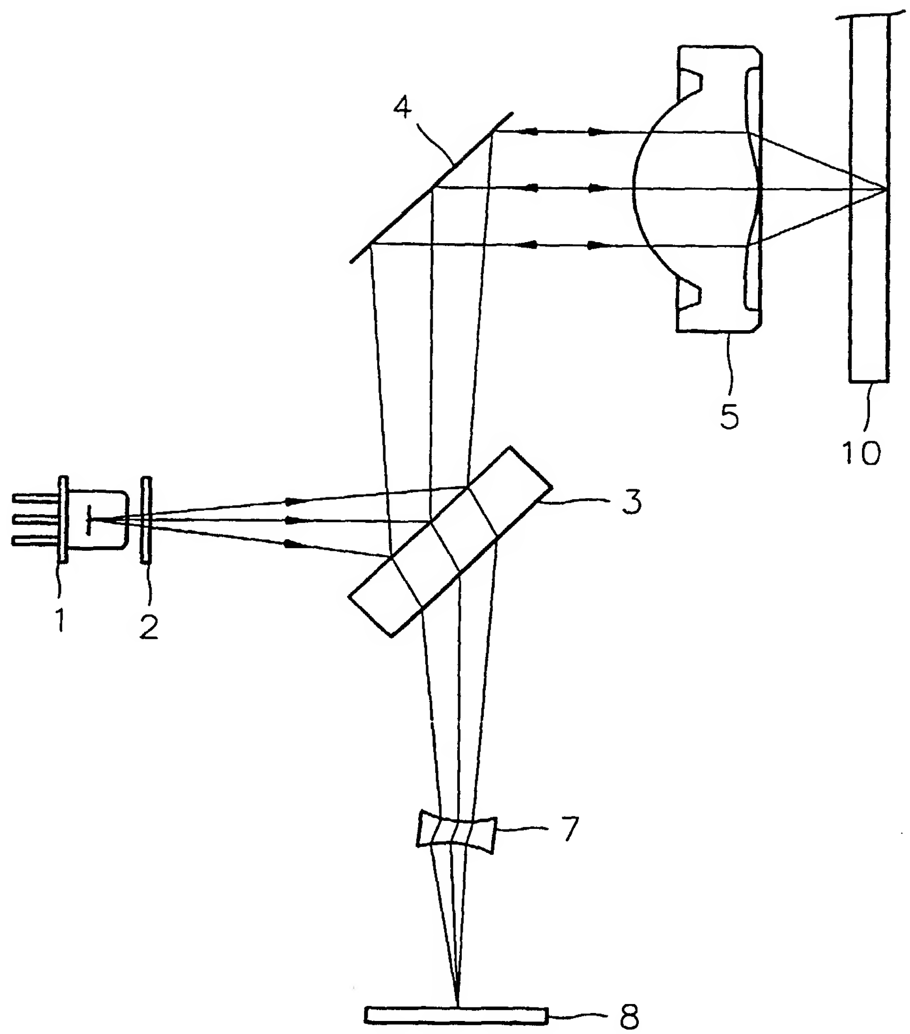


FIG. 2

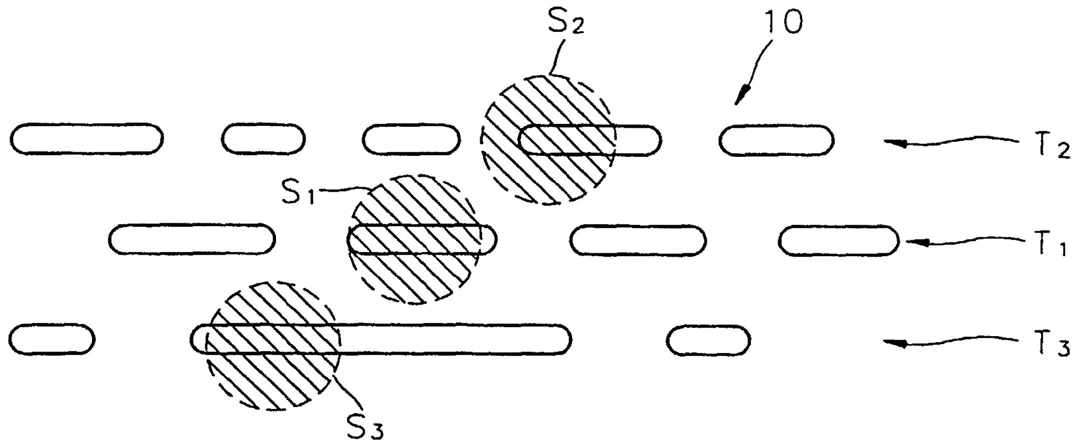



FIG. 3

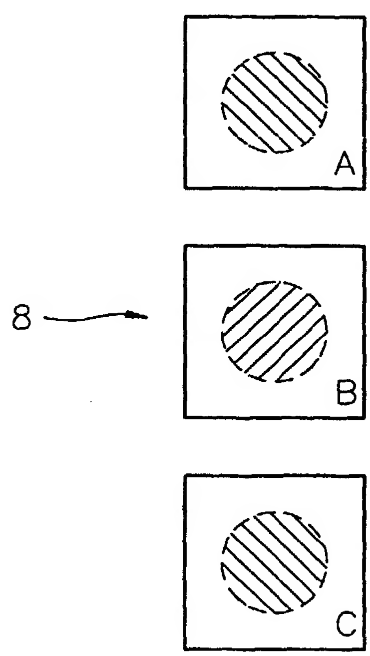


FIG. 4

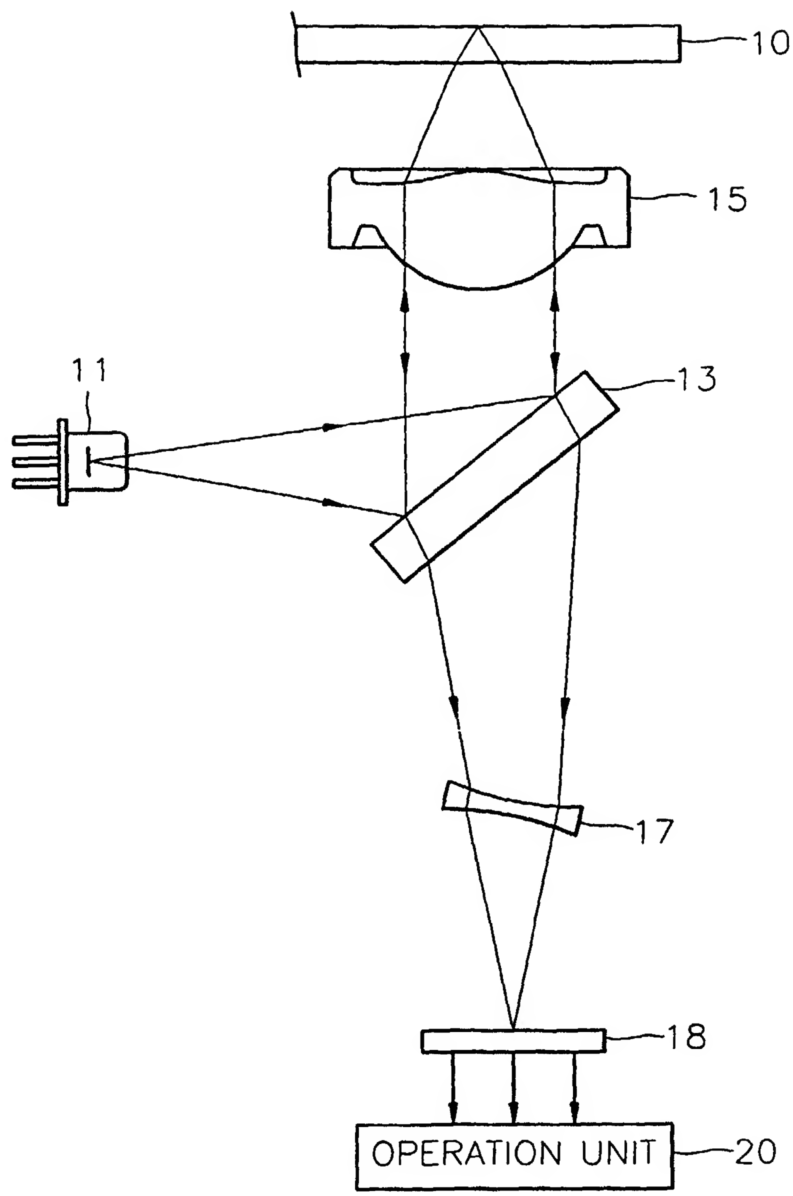


FIG. 5

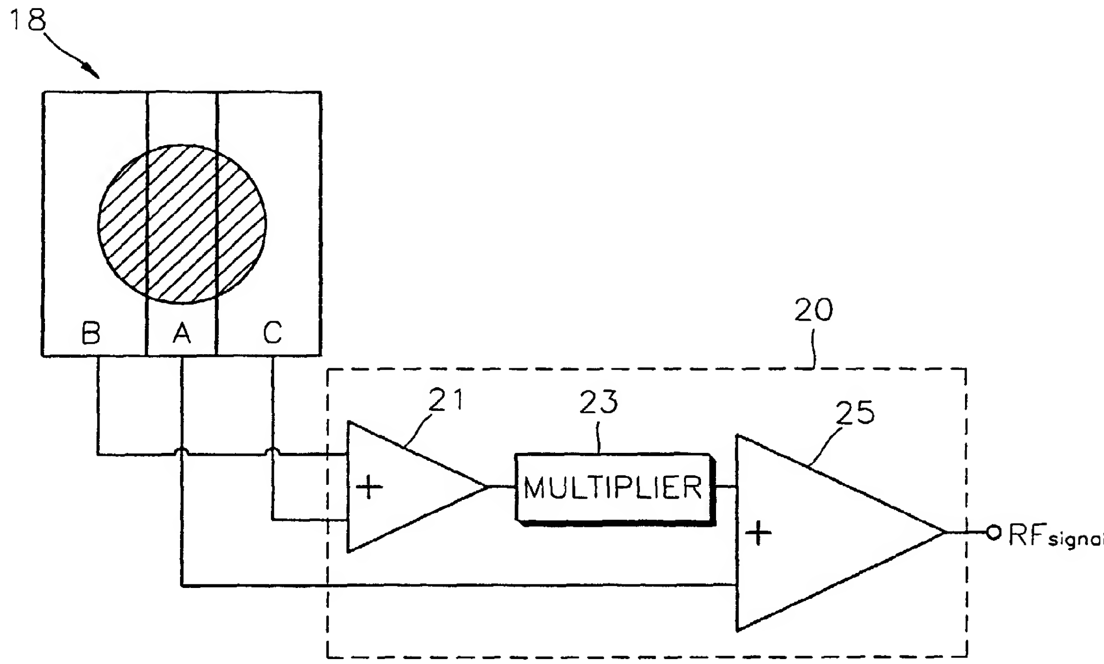

18
B
A
C
20
21
23
25
MULTIPLIER
+
+
RFsignal

FIG. 6

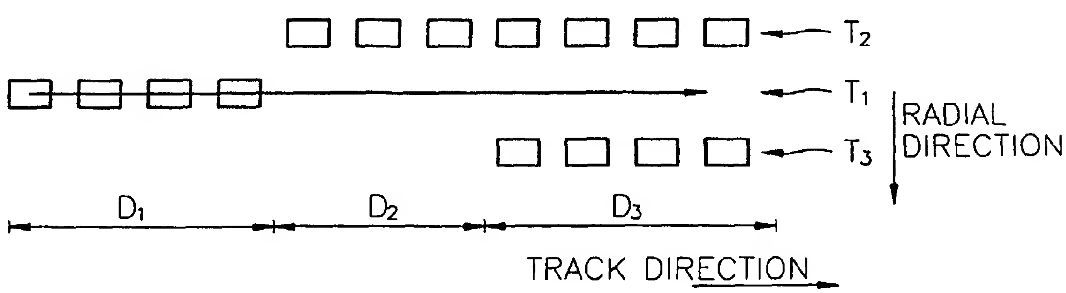

T2
T1
T3
RADIAL DIRECTION
D1
D2
D3
TRACK DIRECTION

FIG. 7

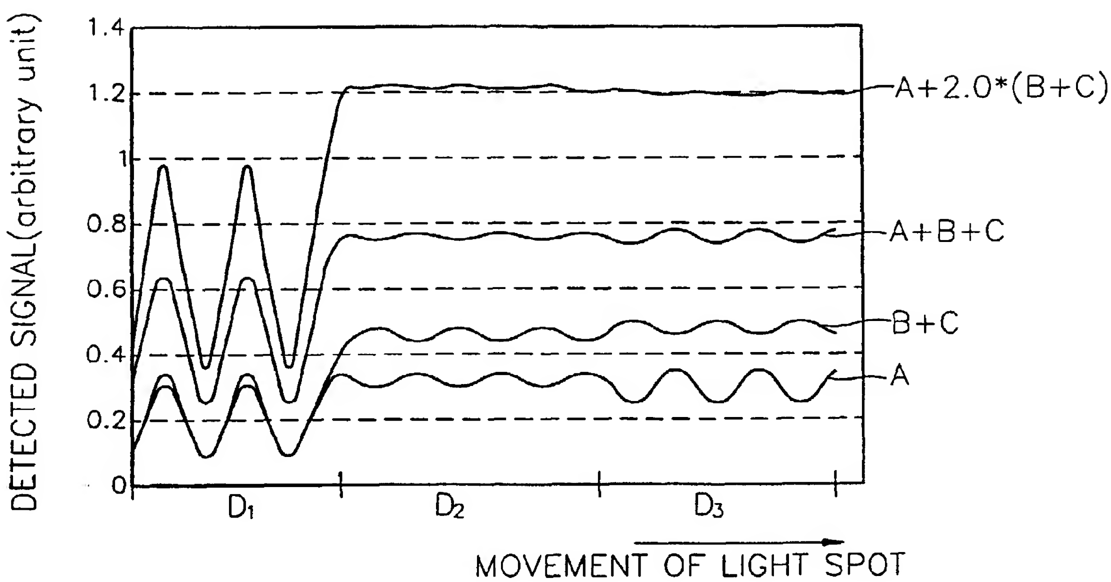

DETECTED SIGNAL(arbitrary unit)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
A+2.0*(B+C)
A+B+C
B+C
A
D1
D2
D3
MOVEMENT OF LIGHT SPOT

FIG. 8A

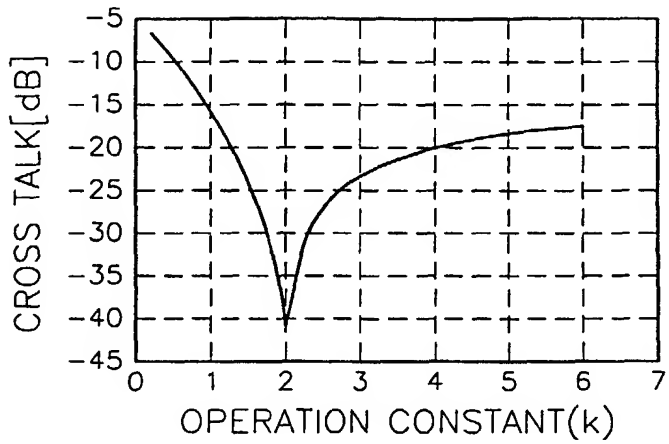

-5
-10
-15
-20
-25
-30
-35
-40
-45
CROSS TALK[dB]
0
1
2
3
4
5
6
7
OPERATION CONSTANT(k)

FIG. 8B

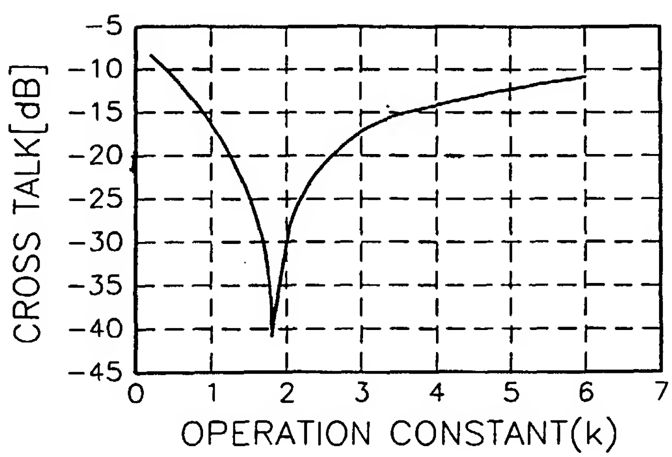

-5
-10
-15
-20
-25
-30
-35
-40
-45
CROSS TALK[dB]
0
1
2
3
4
5
6
7
OPERATION CONSTANT(k)

FIG. 9

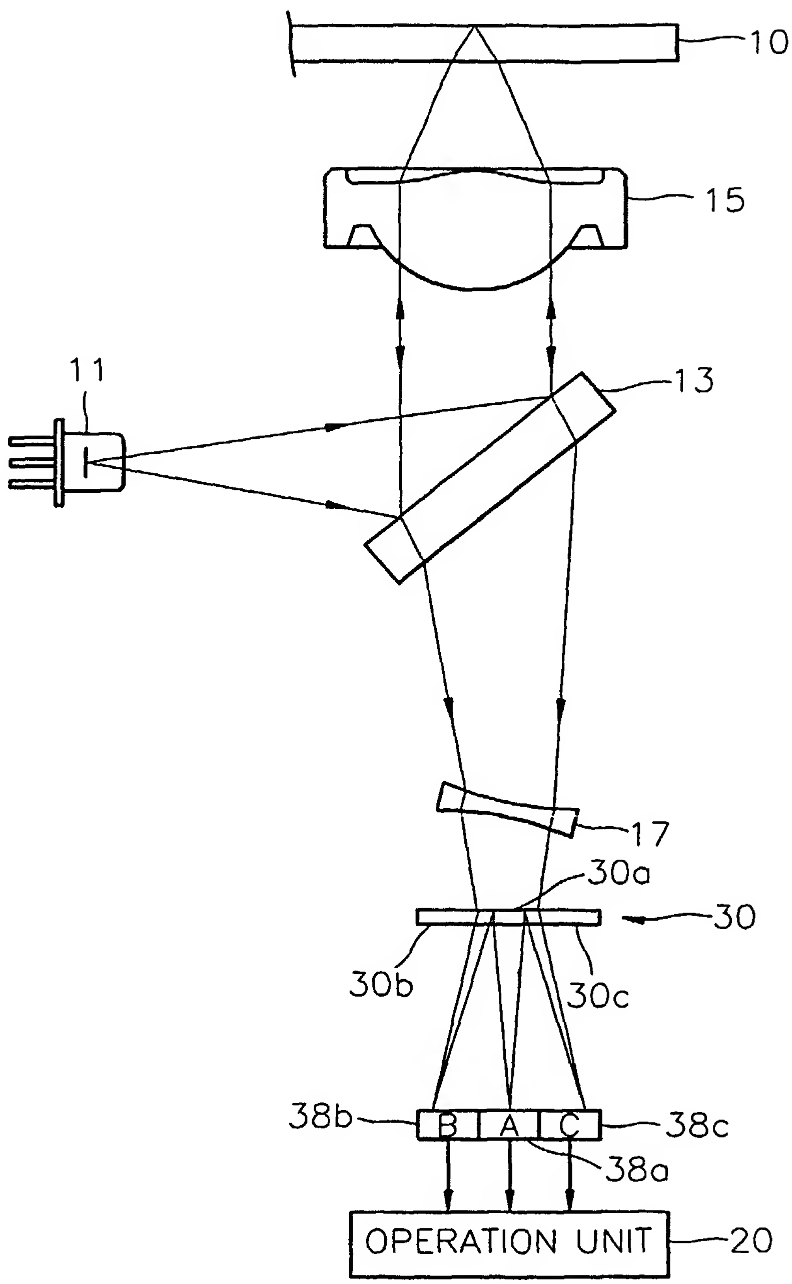


FIG. 10

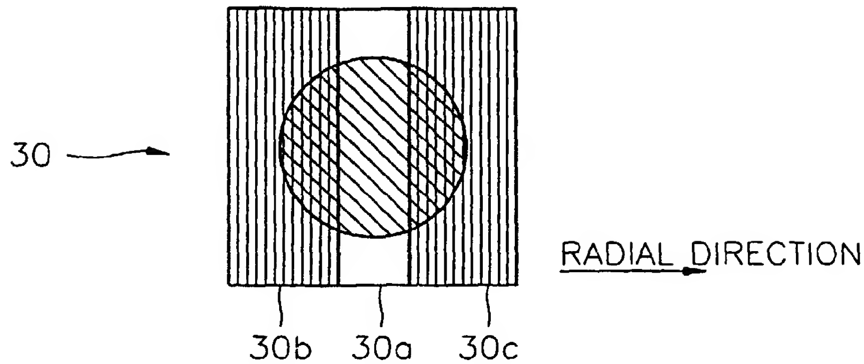
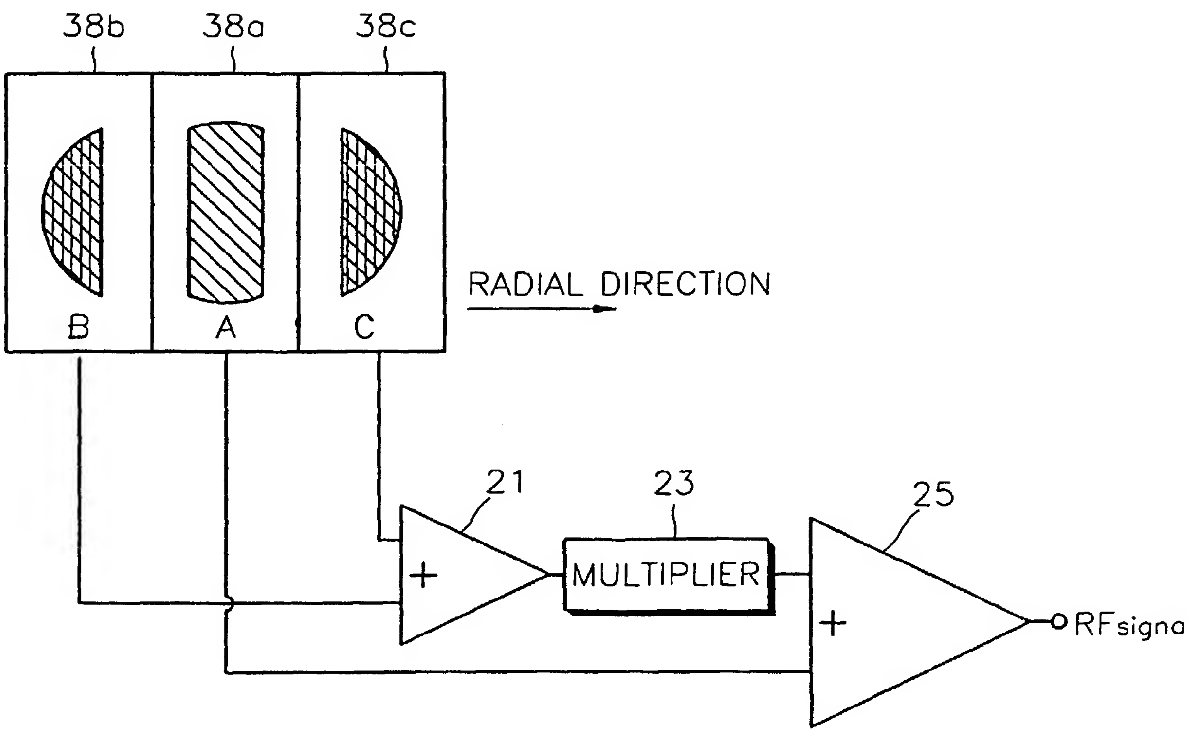

30
RADIAL DIRECTION
30b
30a
30c

FIG. 11


38b
38a
38c
B
A
C
RADIAL DIRECTION
21
23
25
+
MULTIPLIER
+
RFsignal

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 99 31 0505

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
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European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 99 31 0505

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| BERLIN | 12 May 2000 | Quaranta, L |

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EPO FORM 1503 03.82 (P04C01)

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